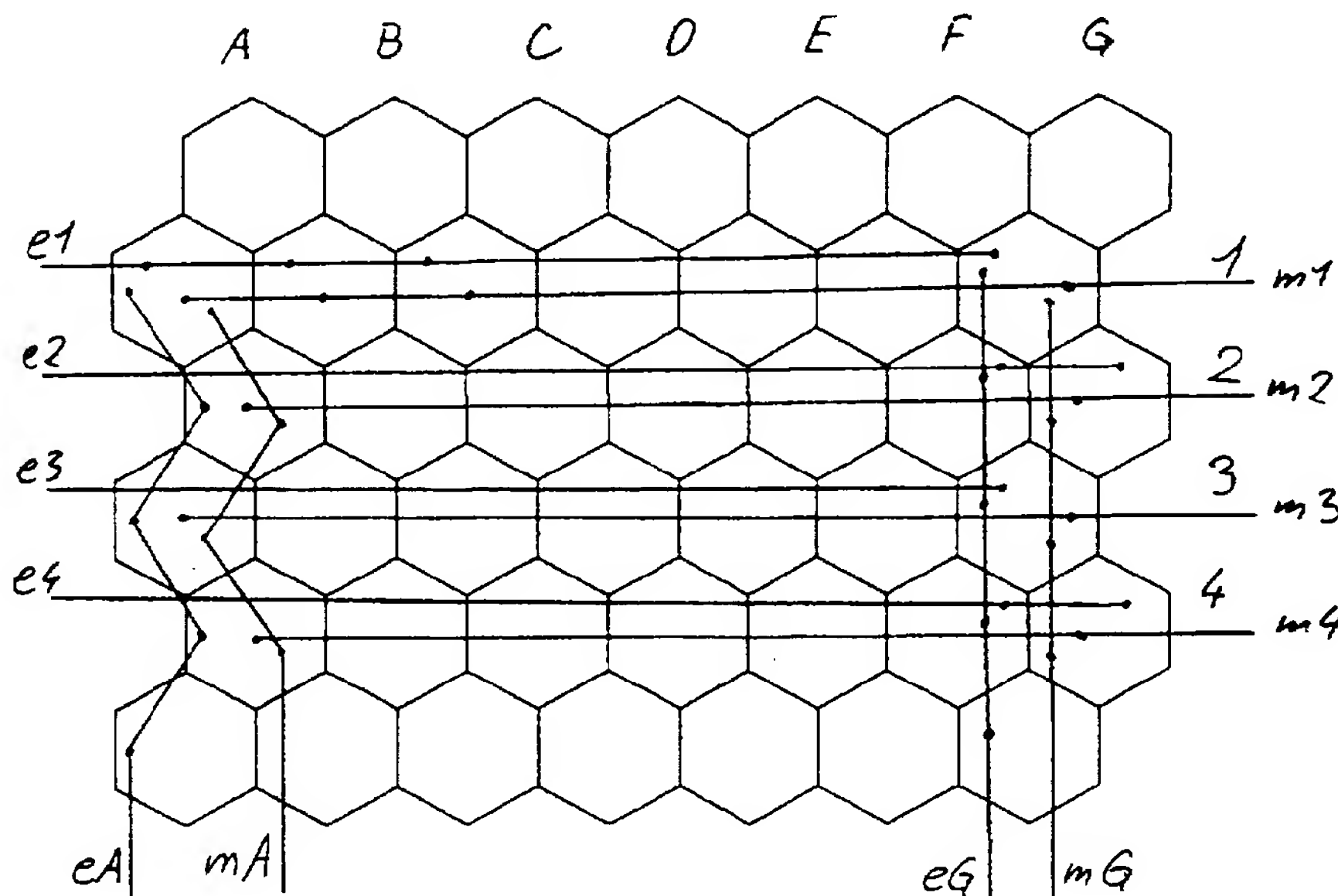




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(21) International Application Number: PCT/DK96/00479 (22) International Filing Date: 21 November 1996 (21.11.96) (30) Priority Data: 1310/95                      21 November 1995 (21.11.95)    DK (71) Applicant (for all designated States except US): AKTIEBO- LAGET ELECTROLUX [SE/SE]; Luxbacken 1, Lilla Es- singen, S-105 45 Stockholm (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): ESKILDSSEN, Christian [DK/DK]; Dammen 14, DK-5591 Gelsted (DK). (74) Agent: BROCK-NANNESTAD, George; Electrolux EPDH Tech-Centre, Sjaellandsgade 2, DK-7000 Fredericia (DK).		(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: A COOKING SURFACE WITH CONTROLS



## (57) Abstract

A cooking surface consists of a large number of cells arranged in an array. The cells are energized according to the thermal load on them so that cells not covered by a cooking utensil are not energized. The control performs clustering of heat load data and calculates the average thermal load. A cooking utensil may be freely moved about on the surface and the heating it requires will be supplied at any placing. The cells may provide the energy in the form of radiant heating or as energy from induction coils in each cell.

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A cooking surface with controls

1

The invention relates to a cooking surface comprising sources of energy and monitoring devices for the thermal load on the surface which control the power supply during use and which switch off the power in the  
5 case of no load being present.

Present-day cooking surfaces generally consist of between one and five hot zones which are distributed below a tough and heat resistant top surface with no specific delimitations other than markings. A hot zone  
10 fitting to the size of the cooking utensil is selected and energized, and the cooking proceeds, possibly controlled automatically, either by temperature sensors directly influenced by the contents or by sensors for the thermal load comprised by the cooking utensil and  
15 the food to be cooked. Such sensors at least have the ability to switch off the power in case there is no load in order that overheating of the cooking utensil or a potentially dangerous situation with a very hot surface is avoided.

20 In early days, a hot top surface for cooking in e.g. restaurants had no delimitation of cooking zones, but the front part (the part nearest to the user) was the hottest, and the rear part was considered the "back burner" and sliding from the front to the back permitted  
25 bringing the food to its desired temperature at the front and letting it continue the cooking at the rear.

In order to obtain a similar function in a modern guise, i.e. a continuous passage from the hotter front to the relatively cooler back of a cooking surface, DE  
30 40 07 680 describes how a number of hot zones are fitted in matrix fashion in conjunction with a vitroc ceramic cooking surface in order that the cooking utensil may be slid along the surface towards the back when a lower temperature is needed. Sensors connected to the hot  
35 zones only switch on those hot zones which are covered by the cooking utensil at any one instant. The described construction aims at avoiding the use of switches or

other user activated controls since switching-on is automatic and the temperature is dependent on the placement of the cooking utensil.

While the above construction gives a good  
5 simulation of the temperature distribution in early days without the constant power consumption and heat loss, there is perceived a need for a cooking surface which will service a number of cooking utensils simultaneously and at the same time to provide individual power supply  
10 in dependence of the food to be cooked while still ensuring full protection against overheating. This need is not addressed by the described German publication DE 40 07 680.

A construction which addresses this need is  
15 particular in that the number of sources of energy is large, with a minimum of 5 sources, preferably a minimum of 20 sources, per cooking utensil to be serviced, and that each source is only energized when its thermal load is determined as sufficient. In this manner, a cooking  
20 utensil may be moved to any place on the cooking surface to make room for other cooking utensils and still retain the cooking desired. One standard size cooking utensil has a diameter of 15 cm, and the number range specified allows proper regulation of the energy supply to each  
25 cooking utensil. The supply of a large number of very small sources of energy ensures an even heating of both small and large cooking utensils and enables the heating of square or rectangular cooking utensils which until now have not been heatable in a relevant manner, except  
30 by putting them in an oven. The determination of thermal load may be performed using devices according to international applications PCT/DK94/00456 and PCT/DK94/00457, to which reference is specifically made. Alternatively, an array of infrared sensors may be used.

35 In a preferred embodiment of the invention the arrangement of the sources of energy is in a matrix fashion. This means that power supply to each source may

occur via columns and rows which reduces the number of switching elements needed to be the sum of columns and rows rather than equal to the total number of sources of heat.

5           In another embodiment the sources of energy are arranged with a minimum of non-heating surface between them. This corresponds to having the maximum of sources of energy within a circular perimeter of a cooking utensil. In this case, the wiring will reflect that such  
10 a configuration is in reality only a distortion of a matrix arrangement as above described.

          In a preferred embodiment the determination of thermal load occurs in conjunction with each source of energy. In this way, not only is each source of energy  
15 only energized when needed, but the precision is enhanced.

          In a further preferred embodiment each point of determination of thermal load communicates with a central control unit which performs clustering of heat  
20 load data and calculation of an average heat load by cooking utensils, in order to control the energy supply to the individual sources of energy. This embodiment makes use of image recognition methods which are easily implemented in data processing chips. The information  
25 that a thermal load is sufficient from a number of thermal load sensors allows clustering into contiguous areas which constitute an image of the instantaneous distribution of cooking utensils on the cooking surface.

          Due to surface irregularities which may appear in  
30 some cooking utensil bottoms a higher precision in thermal load determination may be obtained by averaging the individual determinations in a single cluster, and hence it may be avoided that an individual source of heat is switched off due to a local lack of thermal  
35 load, although sources of heat immediately surrounding it are still switched on.

          In a further embodiment the sources of heat are

constituted by halogen bulbs which are individually energized according to the scheme relevant to this construction. Among other advantages accruing from this construction is the low thermal capacity of each heat  
5 source and its immediate surroundings, enabling a faster reaction to a cooling requirement similar to the desirable qualities of e.g. gas heating.

In a further advantageous embodiment the heat is generated in the cooking utensil by induction coils  
10 which are individually energized in the manner of induction hotplates according to the scheme relevant to this construction. Thereby the top surface temperatures may be held at a still lower value which is a distinct advantage in the present environment comprising a large  
15 number of electronic switches.

The invention will be described in greater detail in the following with reference to the drawing, in which

Fig. 1 shows part of the top of a cooker in which the distribution of a large number of heat sources with  
20 thermal load sensors is indicated,

Fig. 2 shows the perimeter of a cooking utensil covering a number of energy sources with thermal load sensors, as well as lines for communication and energy supply, and

25 Fig. 3 shows a block diagram of the interconnections between the large number of heat sources with thermal load sensors and a control unit.

In Fig. 1 is shown a grid which represents part of the top of a cooker according to the invention. The grid  
30 defines cells by means of row indications (1, 2, 3, 4) and column indications (A, B, C, . . . ., K), it being understood that this section of 44 cells is only a part of the total surface of a cooker in which each cell may be defined by coordinates, such as 1b or 4j. These are  
35 indicated by hatching. Each cell has provisions for energy supply and provisions for measuring the thermal load of the cell, such as a probe to which a connection



may be established.

The cells are supplied with electrical energy by means of a grid of wires (e1, e2, e3, e4) and (eA, eB, eC, ..., eK) respectively. These wires are in turn  
5 connected to main supply wires Wr and Wc by in such a manner that only those cells which are simultaneously connected to both horizontal Wr and vertical Wc main supplies are acting as energy sources in the top of the cooker. The selection of grid wires occurs through  
10 electronic switches in each wire (se1, se2, se3, se4) and (seA, seB, seC, ..., seK). These switches are controlled by a main controller CC for the cooktop.

In a similar fashion, each cell is connected to a grid of sense wires (m1, m2, m3, m4) and (mA, mB, mC, ... mK) respectively which lead to two data buses Mr and  
15 Mc via strobing switches (sm1, sm2, sm3, sm4) and (smA, smB, smC, ..., smK). By means of cyclic strobing, each cell is addressed in turn, and the controller obtains information on the thermal load status of each cell.

20 In Fig. 2 is shown part of a cooktop with a different tessellation. Each cell 1A through 4G is hexagonal which permits a closer approximation to a circular bottom of a cooking vessel. Although a larger number of rows and a smaller number of columns is shown  
25 than in Fig. 1, the designation of the cells has been retained. It will be recognized that the addressing of energy sources and of sensors is identical to the rectangular type grid, although the column grid wires may take two different courses as shown at eA, mA and  
30 eG, mG respectively.

In Fig. 3 is shown a block diagram of the interconnection between the supply and feedback systems and the power supply unit and control unit respectively. According to one embodiment of the invention a primitive  
35 image processing system is involved in that information on clusters of similarly indicating sensors at any one time permits an outline of a thermal load area to be

defined. The cooking vessel is regarded as being positioned within this outline, and the power supplied to each cell is equalized. Alternatively, a subcluster of cells representing a low load area within the outline  
5 may be supplied with a higher level of energy in order to decrease the cooking time, letting the standard reading from the majority of cells within the outline determine if an increasing low load situation, designating dry cooking or removal of a cooking vessel  
10 is occurring.

In one embodiment of the invention, a cooking surface is supplied with a vast number of halogen bulbs with individual reflectors supported by a perforated plate, one hole for each bulb.



## P A T E N T   C L A I M S

1. A cooking surface comprising sources of energy and monitoring devices for the thermal load on the surface which control the power supply during use and which switch off the power in the case of no load being present, characterised in that the number of sources of energy is large, with a minimum of 5 sources, preferably a minimum of 20 sources, per cooking utensil to be serviced, and that each source is only energized when its thermal load is determined as sufficient.

2. A cooking surface according to claim 1, characterised in that the sources of energy are arranged in a matrix fashion.

3. A cooking surface according to claim 2, characterised in that the sources of energy are arranged with a minimum of non-heated surface between them.

4. A cooking surface according to any of the preceding claims, characterised in that the determination of thermal load occurs in conjunction with each source of energy.

5. A cooking surface according to claim 4, characterised in that each point of determination of thermal load communicates with a central control unit which performs clustering of heat load data and calculation of an average heat load by cooking utensils, in order to control the energy supply to the individual sources of energy.

6. A cooking surface according to any of the above claims, characterised in that the sources of energy are constituted by halogen bulbs which are individually energized according to the scheme relevant to this construction.

7. A cooking surface according to any of the  
above claims, c h a r a c t e r i s e d i n  
that the heat is generated in the cooking utensil by  
induction coils which are individually energized in the  
5 manner of induction hotplates according to the scheme  
relevant to this construction.

Fig. 1.

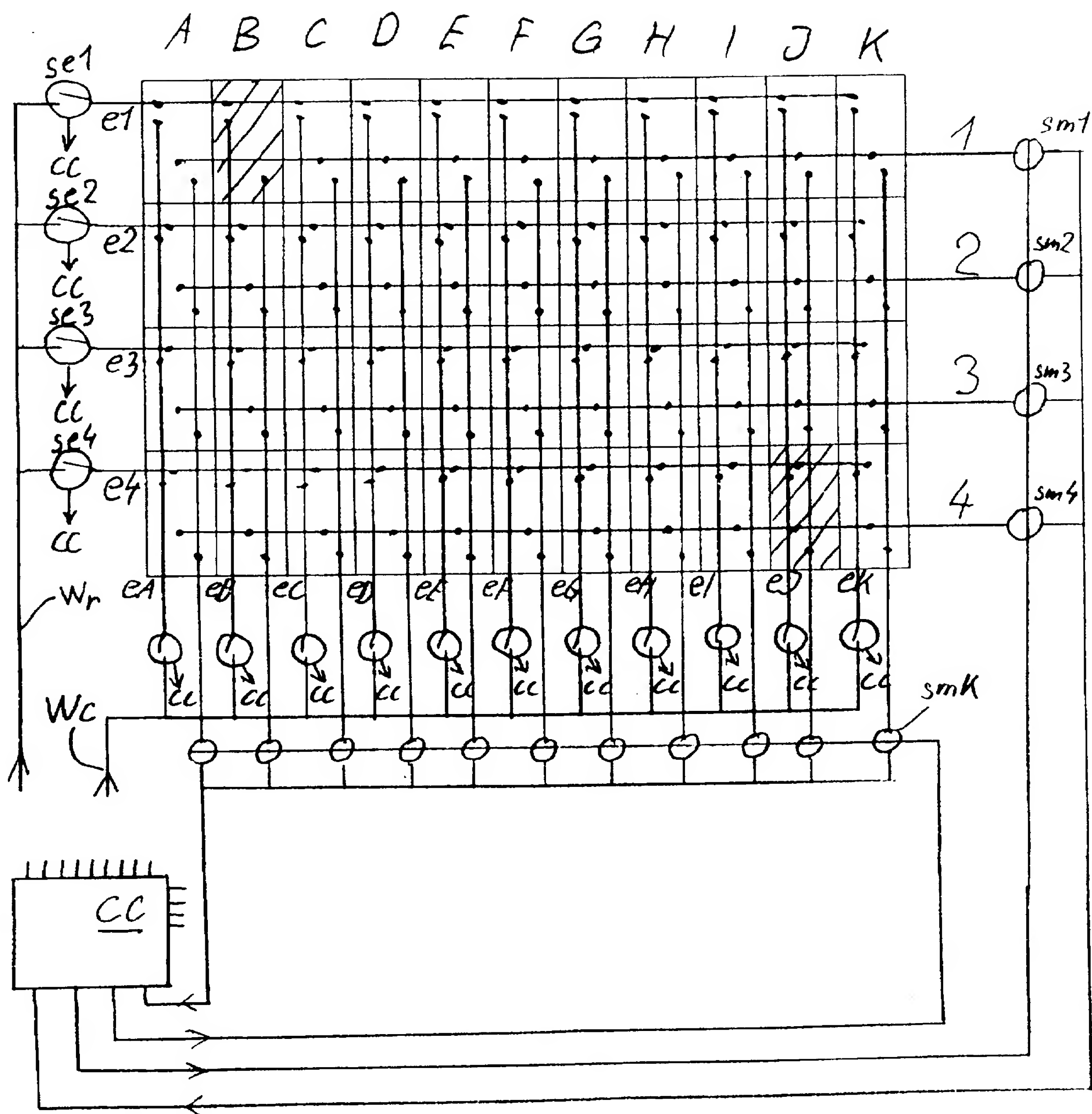


Fig. 2

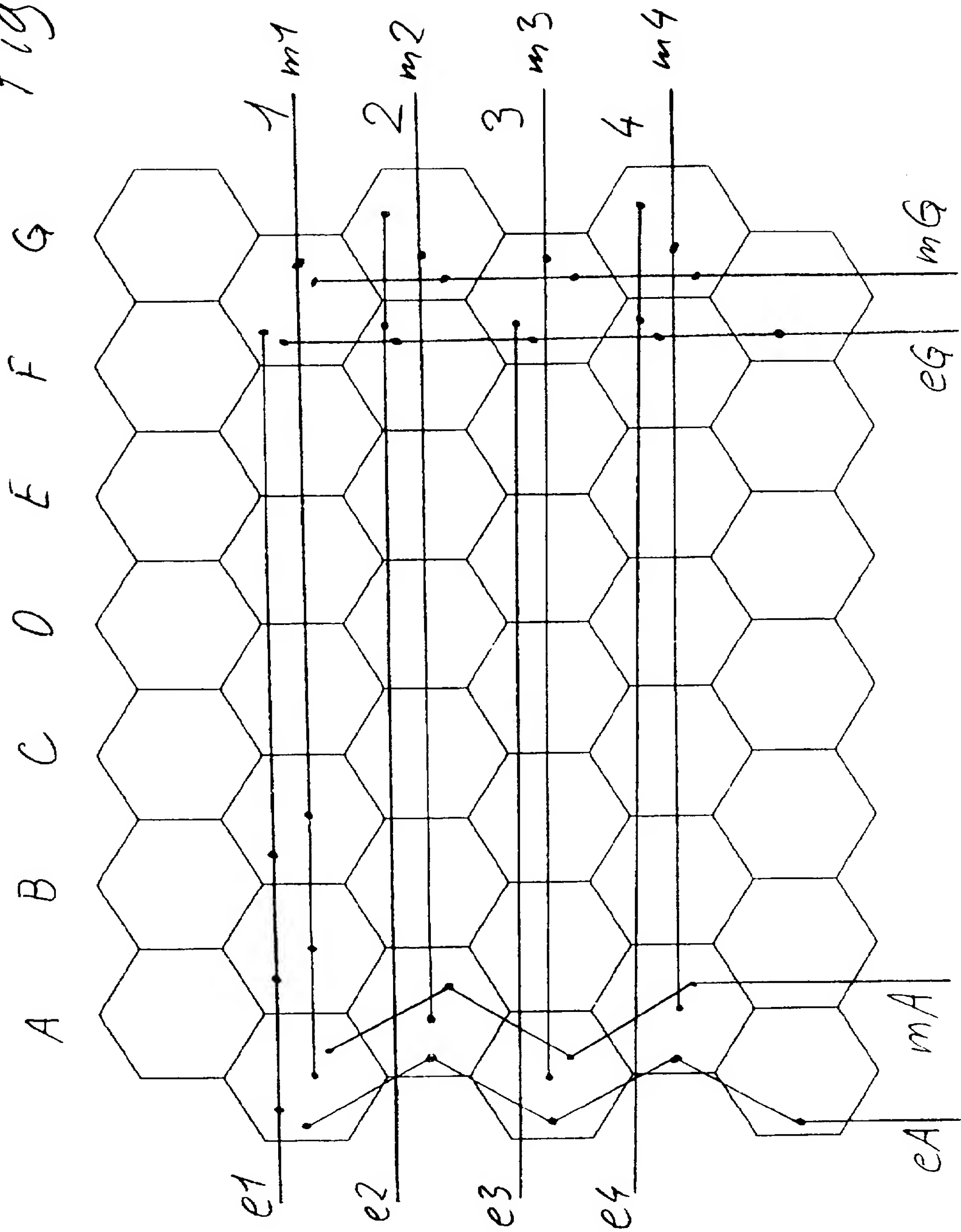
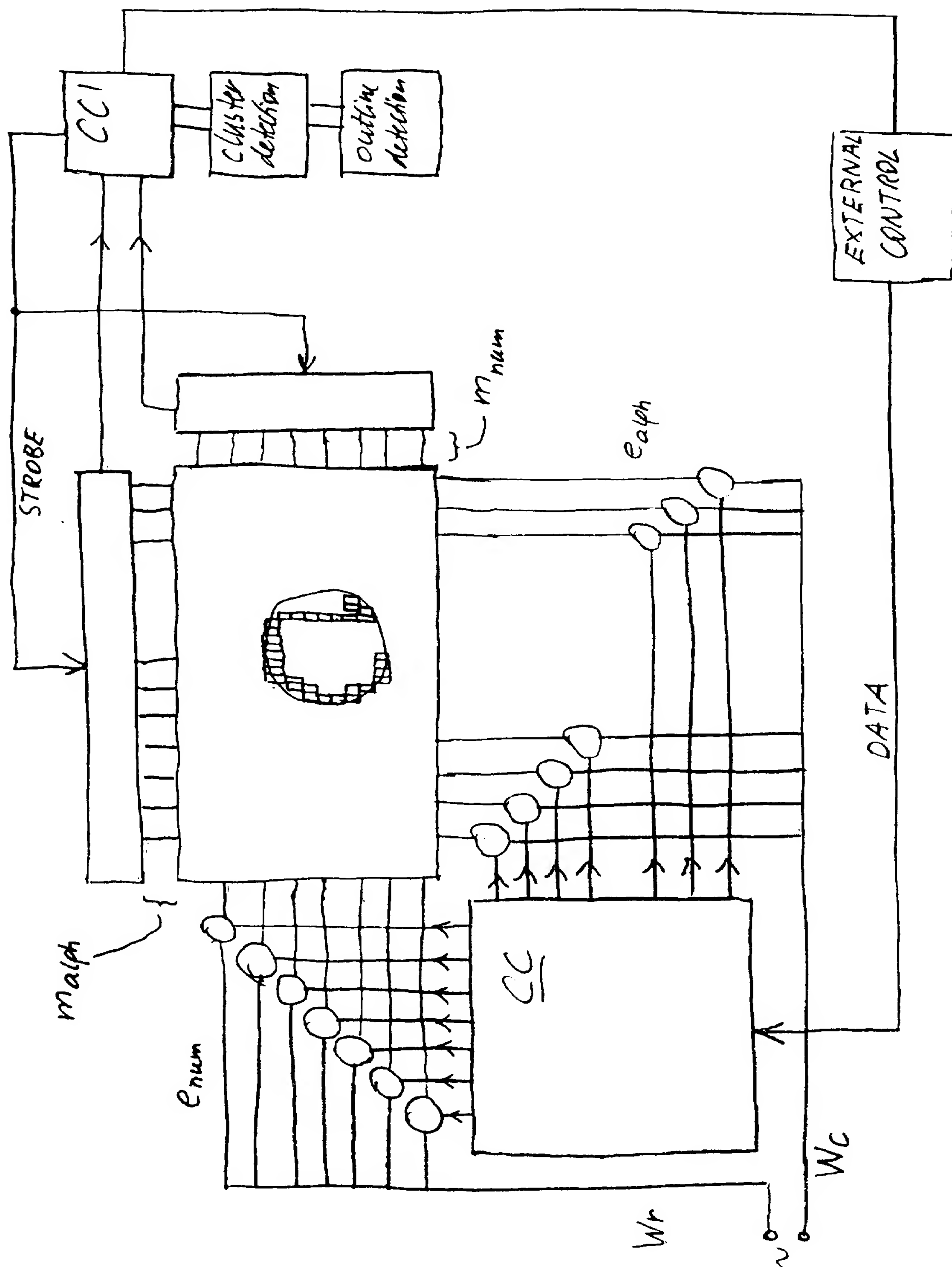


Fig. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 96/00479

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24C 7/08, H05B 3/68

According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)

IPC6: F24C, H05B, G05D

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WPI, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	--	6
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A	US 3953711 A (ECK ET AL), 27 April 1976 (27.04.76), figure 1, abstract	1-7

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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